Important Advances in Clinical Medicine

Epitomes of Progress — Anesthesiology

The Scientific Board of the California Medical Association presents the following inventory of items of progress in anesthesiology. Each item, in the judgment of a panel of knowledgeable physicians, has recently become reasonably firmly established, both as to scientific fact and important clinical significance. The items are presented in simple epitome and an authoritative reference, both to the item itself and to the subject as a whole, is generally given for those who may be unfamiliar with a particular item. The purpose is to assist the busy practitioner, student, research worker or scholar to stay abreast of these items of progress in anesthesiology which have recently achieved a substantial degree of authoritative acceptance, whether in his own field of special interest or another.

The items of progress listed below were selected by the Advisory Panel to the Section on Anesthesiology of the Californa Medical Association and the summaries were prepared under its direction.

Reprint requests to: Division of Scientific and Educational Activities, California Medical Association, 731 Market St., San Francisco, CA 94103

Glycopyrrolate: A Challenge to Atropine

ATROPINE, a naturally-occurring belladonna alkaloid, is frequently used during anesthesia as the antimuscarinic drug of choice for premedication, for treatment of bradycardia and, in conjunction with a cholinergic drug, for reversal of the effects of nondepolarizing muscle relaxants. Its popularity persists despite several shortcomings. As premedication its short duration of action (1 to 1½ hours when given intramuscularly) often means that the vagal blocking effects have lapsed before induction of anesthesia; its tertiary ammonium structure allows it to readily cross the blood-brain barrier, resulting in unwanted central effects; and the tachycardia and occasional dysrhythmias following intravenous use may be undesirable and potentially dangerous in some patients.

The search for an antimuscarinic agent without the inherent disadvantages of atropine has led to the synthesis of several quaternary ammonium substitutes. Glycopyrrolate (Robinul®) introduced in 1960, has much to recommend its use over atropine in anesthesia and surgical procedures. Its quaternary ammonium, highly polarized structure does not readily permit passage across the blood-brain barrier, resulting in a greatly reduced incidence of central anticholinergic effects. The longer duration of action (four to six hours when given intramuscularly) favors its use as a premedication to protect against vagal reflexes induced by drugs, intubation or surgical manipulations. A significant reduction in gastric volume and acidity compared with atropine serves to protect against serious sequelae of aspiration.

In the reversal of neuromuscular blocking drugs, glycopyrrolate protects as well as atropine against the muscarinic effects of reversal drugs, with less tachycardia and lower incidence of dysrhythmias. When given intravenously, the duration of antimuscarinic action of glycopyrrolate is three to four hours longer than the duration of cholinergic activity of both neostigmine and pyridostigmine. The incidence of all muscarinic complications is decreased.

Only in the treatment of severe bradycardia, caused by increased vagal tone, may atropine be preferred to glycopyrrolate because of its greater effectiveness in increasing pulse rate. In all other pharmacological actions, glycopyrrolate appears to have decided advantages.

KENNETH S. CHING, MD

REFERENCES

Ramamurthy S, Shaker MH, Winnie AP: Glycopyrrolate as a substitute for atropine in neostigmine reversal of muscle relaxant drugs. Can Anaesth Soc J 19:399-411, Jul 1972

Goodman LS, Gilman A (Eds): The Pharmacological Basis of Therapeutics, 5th Ed. New York, Macmillan, 1975, Chap 25

The Pulmonary Artery Catheter for Measurement of Left Ventricular Function

ASSESSMENT of left ventricular performance and reserve is important for diagnostic evaluation and treatment of critically ill patients in an intensive care unit (ICU) and during major surgical procedures. Ventricular performance is determined primarily by heart rate and cardiac contractility, preload and afterload.

The heart rate is measured easily from an electrocardiographic monitor. If diastolic filling is maintained constant, cardiac output will increase as heart rate increases. Myocardial contractility may be assessed indirectly by invasive or noninvasive methods, but a practical method for continuous monitoring of contractility is not yet available in clinical practice. Afterload is the myocardial wall tension developed during contraction and is proportional to arterial blood pressure. Therefore, it is easily assessed by conventional blood pressure monitoring.

The accurate assessment of preload, defined as myocardial fiber length at the end of diastole, presents a difficult problem. Preload is related to ventricular volume, and ventricular volume is, in turn, roughly proportional to left ventricular end-diastolic pressure (LVEDP). Although ventricular volume and LVEDP change in the same direction, the relationship is not linear in normal hearts and it is further altered by conditions which change myocardial compliance. Mean left atrial pressure (MLAP) is frequently used in the clinical setting to assess LVEDP since the two are nearly identical in patients with normal hearts, but MLAP is an inaccurate reflection of LVEDP in patients with abnormal left ventricular function, and it can only be measured by direct insertion of a catheter through the left atrial wall at operation.

The introduction of a balloon-tipped flow-directed pulmonary artery catheter made available an effective and reasonably safe clinical method for assessment of MLAP (and, therefore, indirectly, preload).

In its simplest form, the pulmonary artery catheter has two lumina. One extends the entire length of the catheter, opening at the tip, through which it is possible to measure pressure and collect blood samples. The other lumen opens just proximal to the catheter tip and is used to inflate the balloon. When the catheter is placed in a peripheral branch of a pulmonary artery, balloon inflation will obstruct arterial blood flow in that segment of the pulmonary arterial system. The pressure then recorded beyond the balloon is no longer pulmonary artery pressure but becomes the pressure transmitted retrograde from the left atrium. This pulmonary artery occluded pressure (PAOP) is essentially identical to pulmonary wedge pressure (PWP). A close relationship exists between MLAP and PWP when PWP is less than 25 mm of mercury. Measurement of PAOP consequently allows for a relatively accurate determination of MLAP which in turn corresponds to LVEDP. As LVEDP increases so does PAOP.

Modifications of the catheter include an additional lumen which opens into the right atrium, and a thermistor probe 10 cm proximal to the tip of the catheter, for measuring cardiac output by thermodilution. The versatility of the pulmonary artery catheter is notably increased by these two additions. For example, it is also possible utilizing body surface area, heart rate, cardiac output, mean arterial pressure, mean right atrial pressure and PAOP to calculate stroke volume index, total peripheral resistance, pulmonary vascular resistance, and left and right ventricular stroke work index.

Because of the disparity between central venous pressure and PAOP in patients with compromised left ventricular function, uncompensated cirrhosis, advanced peritonitis or multisystem trauma, catherization of the pulmonary artery is indicated for adequate monitoring of fluid therapy or a hemodynamic intervention in the ICU or during anesthesia. Other uses are in the management of patients during controlled hypotension and in monitoring massive volume replacement.

Premature ventricular contractions may occur during 17 percent of attempted catheter placements. The arrhythmias are transient, and usually